Green University of Bangladesh

Department of Computer Science and Engineering (CSE)
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A Banking System Network with additional security

Course Title: Computer Networking Lab
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Lab Project Status

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Comments:	**Date:**

Contents

Chapter 1

Introduction

1.1 Overview

The project aims to design and implement a secure banking system network using Cisco technologies. The network will include all necessary components to support a banking system, including servers, routers, switches, firewalls, and other security devices. The system will ensure the confidentiality, integrity, and availability of customer data and transactions.

1.2 Motivation

The banking industry is one of the most heavily regulated industries with strict security and compliance requirements. A secure and reliable network infrastructure is essential for banks to ensure customer trust and confidence. Cybersecurity threats are constantly evolving, and banks need to stay ahead of these threats to protect customer data and prevent financial losses. Therefore, this project aims to develop a secure banking system network that meets the industry standards and regulations.

1.3 Problem Definition

1.3.1 Problem Statement

The problem is to design and implement a secure banking system network that ensures the confidentiality, integrity, and availability of customer data and transactions. The network should also comply with the industry standards and regulations.

1.3.2 Complex Engineering Problem

The project involves complex engineering problems as it requires a deep understanding of network architecture, security protocols, and compliance regulations. The design and implementation of a secure banking system network require a range of conflicting requirements, including security, performance, scalability, and availability.

Attributes of the Problem and How to Address Them

- P1: Depth of knowledge required - Extensive knowledge of networking and security, as well as banking regulations, is required to design and implement a secure banking system network.
- P2: Range of conflicting requirements - The network should meet the security requirements of the bank and its customers while also complying with banking regulations and industry standards.
- P3: Depth of analysis required - Detailed analysis is required to identify potential security threats and vulnerabilities in the banking system network.
- P4: Extent of stakeholder involvement and conflicting requirements - Stakeholders, including customers, bank employees, and regulatory bodies, must be involved in the design and implementation of the network.

1.4 Design Goals/Objectives

The design goals/objectives of the project include:

Security

The banking system network must be designed with the highest level of security to protect customer data and prevent cyber attacks.

Compliance

The network must comply with the industry standards and regulations, including the Payment Card Industry Data Security Standard (PCI DSS), the Sarbanes-Oxley Act (SOX), and the Gramm-Leach-Bliley Act (GLBA).

Performance

The network should be designed to ensure optimal performance and minimize latency for banking transactions.

Scalability

The network should be designed to accommodate future growth and scalability requirements.

Availability

The network must ensure high availability to prevent downtime and ensure continuous banking operations.

Monitoring

The network should be monitored continuously to detect and prevent any security threats.

Disaster Recovery

The network should have a disaster recovery plan in place to ensure business continuity in case of any natural or man-made disasters.

1.5 Application

The application of this project is in the real-world banking industry, where banks need to securely manage and process financial transactions between customers and the bank. This project will help banks to implement a secure network infrastructure that can prevent cyber-attacks and data breaches and ensure compliance with relevant industry standards. The secure network infrastructure will also help to maintain customer trust and confidence in the bank's ability to safeguard their sensitive financial information.

Chapter 2

Design/Development/Implementation of the Project

2.1 Introduction

In this project we will primarily focus on design and implementation of Banking System Network using Cisco Packet Tracer (CPT). Security breach in the sector of banks is one of the most important concerns that needs to be addressed in the first place since loss of information can lead to huge losses to the bank overall. This project will help us curb such concerns by understanding the regulated flow of information/data.

We will consider a bank named Bangladesh Development Bank that is planning to have 6 departments allocated on their new branch in Dhaka City. The bank needs to have departments of internal IT supports, ATM services, consumer banking, investment banking, loans and insurance. All their departments network is separated but able to communicate with each other using an internal chatting system using a port.

2.2 Project Details

2.2.1 Network Scope

This project network is designed for Bangladesh Development Bank in Dhaka City, requires 6 main departments for their new outlet which are:

- Internal IT support
- ATM services
- Consumer Banking
- Investment Banking
- Loans
- Insurance

2.2.2 Devices & Equipment Used

IT Department

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
IT Admin	PC-PT	Fe0	192.168.10.100	255.255.255.0	192.168.10.1
IT Admin2	PC-PT	Fe0	192.168.10.200	255.255.255.0	192.168.10.1
Server	Server-PT	Fe0	192.168.10.254	255.255.255.0	N/A
SwitchIT	2960-24TT	N/A	N/A	N/A	N/A

ATM

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
ATM	PC-PT	Fe0	192.168.20.101	255.255.255.0	192.168.20.1
ATM2	PC-PT	Fe0	192.168.20.201	255.255.255.0	192.168.20.1
ATM3	PC-PT	Fe0	192.168.20.301	255.255.255.0	192.168.20.1
SwitchATM	2960-24TT	N/A	N/A	N/A	N/A

Consumer Banking

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
ConsumPC	PC-PT	Fe0	192.168.30.101	255.255.255.0	192.168.30.1
ConsumPC2	PC-PT	Fe0	192.168.30.201	255.255.255.0	192.168.30.1
ConsumPC3	PC-PT	Fe0	192.168.30.301	255.255.255.0	192.168.30.1
SwitchConsumer	2960-24TT	N/A	N/A	N/A	N/A

Investment Banking

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
InvestPC	PC-PT	Fe0	192.168.40.101	255.255.255.0	192.168.40.1
InvestPC2	PC-PT	Fe0	192.168.40.201	255.255.255.0	192.168.40.1
InvestPC3	PC-PT	Fe0	192.168.40.301	255.255.255.0	192.168.40.1
SwitchInvest	2960-24TT	N/A	N/A	N/A	N/A

Loans

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
LoansPC	PC-PT	Fe0	192.168.50.101	255.255.255.0	192.168.50.1
LoansPC2	PC-PT	Fe0	192.168.50.201	255.255.255.0	192.168.50.1
LoansPC3	PC-PT	Fe0	192.168.50.301	255.255.255.0	192.168.50.1
SwitchLoans	2960-24TT	N/A	N/A	N/A	N/A

Insurance

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
InsuPC	PC-PT	Fe0	192.168.60.101	255.255.255.0	192.168.60.1
InsuPC2	PC-PT	Fe0	192.168.60.201	255.255.255.0	192.168.60.1
InsuPC3	PC-PT	Fe0	192.168.60.301	255.255.255.0	192.168.60.1
SwitchInsu	2960-24TT	N/A	N/A	N/A	N/A

Guest WIFI

Device	Model	Port	IP Address	Subnet Mask	Default Gate-way
Guest-Wifi Router	HomeRouter-PT-AC	N/A	N/A	N/A	N/A
GuestDevice	SMARTPHONEE-PT	Wireless 0	192.168.70.2	255.255.255.0	192.168.70.1

Multilayer Switch

Device	Model	Port	IP Address	Subnet Mask	Default Gateway
Multi-sw 1(MAIN)	3650-24PS	Vlan10	192.168.10.1	255.255.255.0	N/A
		Vlan11	192.168.20.1	255.255.255.0	
		Vlan12	192.168.30.1	255.255.255.0	
		Vlan13	192.168.40.1	255.255.255.0	
		Vlan14	192.168.50.1	255.255.255.0	
		Vlan15	192.168.60.1	255.255.255.0	
		Vlan16	192.168.70.1	255.255.255.0	
		Vlan17	192.168.80.1	255.255.255.0	

2.2.3 Operational Objectives

Below are the main goals of the network being to achieve several operational objectives which are:

- Every department network is separated. All staffs can communicate through emails and an internal chatting system using port 465.
- There should be a guest Wi-Fi is provided to customers. This is an isolated network with only web browsing capabilities.
- The IT department consists of a small team that the staffs are mainly performing operational tasks instead of planning and implementations.
- This system should maintain a balance between network performance and security.

2.2.4 Design Features and Coverage

One of the features that we apply in this network system is ACL (Access Control-List), which is a network security feature used to control and filter network traffic based on predefined rules.

VLAN	ACL Permission
Vlan10: IT Department	- Remote access (SSH) to all the networking devices for troubleshooting, except ATM network. - Perform remote into the branch through VPN for troubleshooting. - Perform remote into the branch through VPN for troubleshooting.
Vlan11: ATM	- Isolated network and directly connect to Headquarter network through 5556 port. - All staffs including IT support has no access to the ATM network.
Vlan12: Consumer Banking	- Communicate through emails and an internal chatting system using port 465.
Vlan13: Investment Banking	- Communicate through emails and an internal chatting system using port 465. - Internet access (HTTP and HTTPS only) to support overseas customers.
Vlan14: Loans	- Communicate through emails and an internal chatting system using port 465. - Internet access with port 9999 to check customer credit scores.
Vlan15: Insurance	- Communicate through emails and an internal chatting system using port 465. - Port 7772 to connect to national insurance portal. - No internet access.
Vlan16: Guest Wifi	- Only can connect to WiFi

Table 2.1: Access Control List Permissions

2.2.5 Number of Users and Priority Levels

This network design is only meant for a small scale organisation where the access point could support approximately 200 users.

The consumer department would be the main users that occupies 60% of the network usage while the IT department would have the highest priority where they are tasked with taking care of networking devices of BDB bank and they are able to Access all the department's network with the ability to provide VPN services to remote department and perform actions. The ATM department occupies 15% of the network usage and it is isolated network and directly connect to Headquarter network. The loans and

Investment Department will also occupies 10% each of the network usage for check the customer credit score and support overseas customers. While the rest of the departments are within low priority as they do not require to use the network extensively compared to the other departments.

2.2.6 Security Requirements

Here are the main objectives of our network's security requirements which comprises of:

- Users are required to change their password every 90 days.
- The IT Department are given the privilege to access all the group's network and they are able to conduct troubleshooting activities remotely to all the group's network.
- Firewalls will be implemented within the server to prevent unauthorized users from accessing the networks.

2.3 Implementation

Network Diagram and Topologies

2.3.1 Site 1 – IT Department

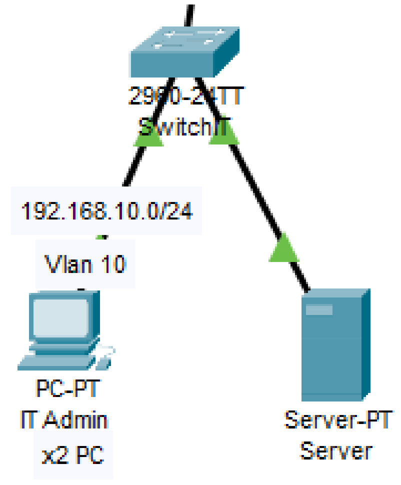

Figure 2.1: Site 1 – IT Department

This site consists of 2 IT administrators, and 1 server. The default gateway got IT Department is 192.168.10.1/24. IT Department is using VLAN 10 to control access between the groups.

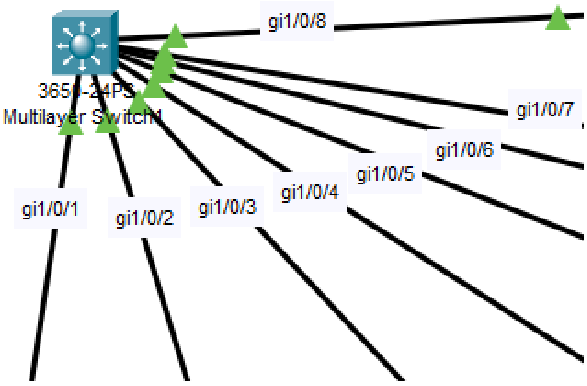

Figure 2.2: Main Multilayer Switch (Layer 3 Switch)

Trunk (encapsulation dot1q) is used at the Multilayer switch (layer 3 switch) as we want create VLAN traffic between the switches. A trunk connection is a normal link that is able to pass traffic from different VLANs and has a method to separate traffic between VLANs. DHCP protocol are used on layer 3 switch so that it could enable automatic assignment of IP configurations for nodes on the network. It is efficient as we do not have to assign all the IP addresses manually. The DHCP server accepts address assignment requests and renewals from the client and assigns the addresses from predefined groups of addresses within DHCP address pools. These address pools are also be configured to supply additional information to the requesting client such as the IP address of the Domain Name System (DNS) server.

Site 2 – ATM

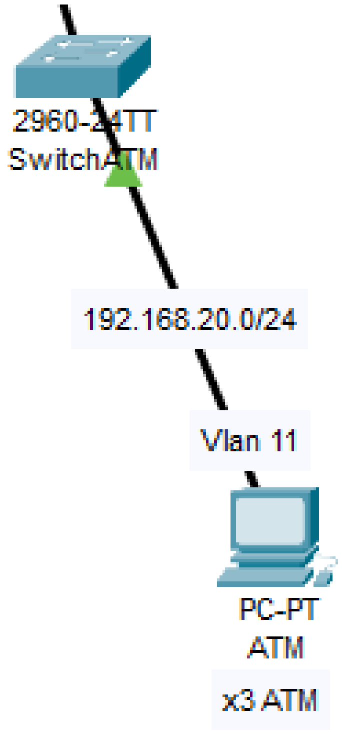

Figure 2.3: Site 2 – ATM

As for site 2, this would be the ATM Department which consists 3 ATM and 1 Switch of ATM. ATM Department is using VLAN 11 to control access between the departments.

Site 3 – Consumer Banking

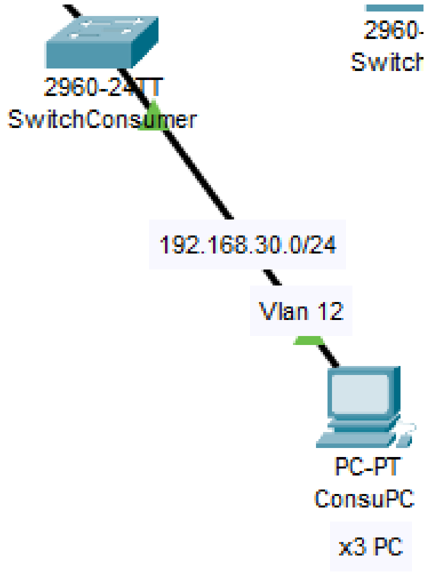

Figure 2.4: Site 3 – Consumer Banking

The figure above is the site dedicated for the Consumer Banking department. It consists 3 Consumer PC and 1 Switch for Consumer Department, and it's using VLAN 12 to control access between the departments.

Site 4 – Investment Banking

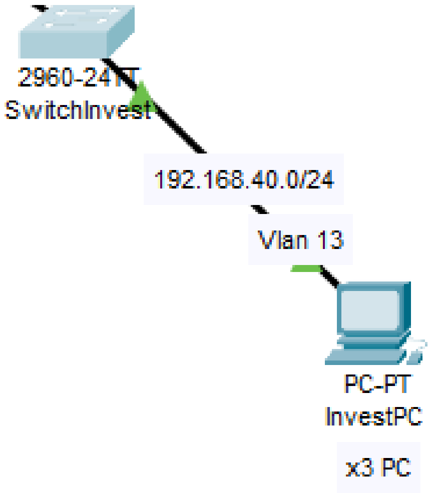

Figure 2.5: Site 4 – Investment Banking

As for Site 4, This is Investment Banking which consists 3 PC of Investment and 1 switch for using VLAN 13 to control access between the department.

Site 5 – Loans

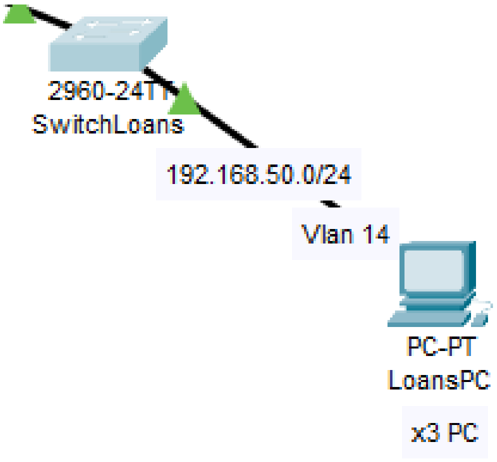

Figure 2.6: Site 5 – Loans

This Site 5 is for the Loans Department and its consists 3 Loans PC for staff and 1 switch for Loans Department. Its using VLAN 14 to control access between the departments.

Site 6 – Insurance

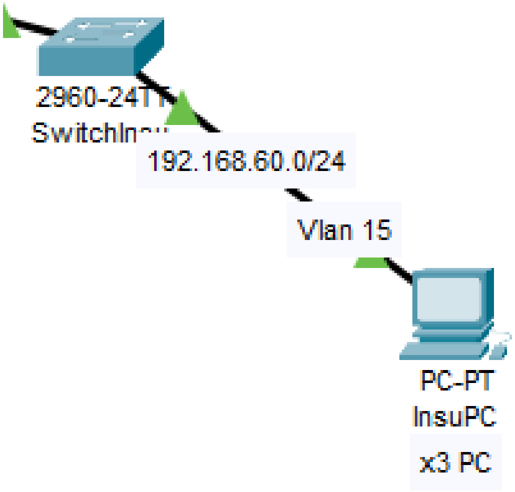

Figure 2.7: Site 6 – Insurance

The figure above is the site dedicated for the Insurance department. It consists 3 Insurance PC for staff and 1 Switch for Insurance Department, and it's using VLAN 15 to control access between the departments.

Site 7 – Guest Wifi

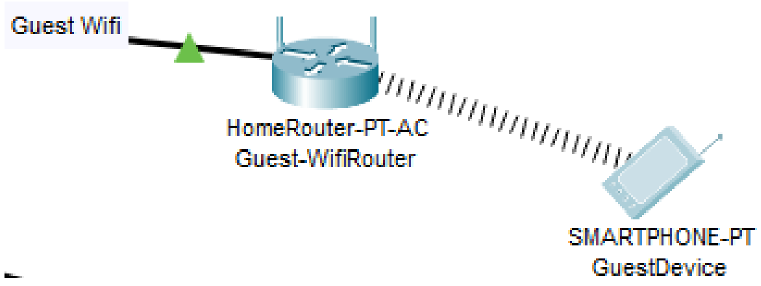

Figure 2.8: Site 7 – Guest Wifi

As for Site 4, This is Guest Wifi Design which only consists 1 Wireless router and 1 example device of user for access into internet. Its using VLAN 16 that only allow users to access the internet.

Site 8 – Site-to-site VPN

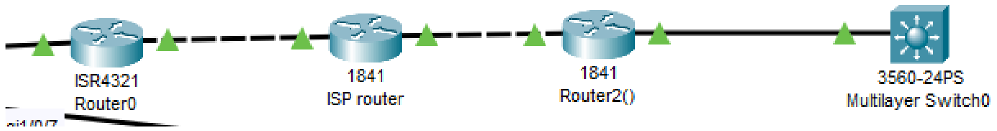

Figure 2.9: Site 8 – Site-to-site VPN

Site-to-Site IPSec VPN Tunnels are used to allow the secure transmission of data and perform remote into the branch for troubleshooting. The VPN tunnel is created over the Internet public network and encrypted using a number of advanced encryption algorithms to provide confidentiality of the data transmitted between the two sites.

Chapter 3

Performance Evaluation

3.1 Simulation Environment/ Simulation Procedure

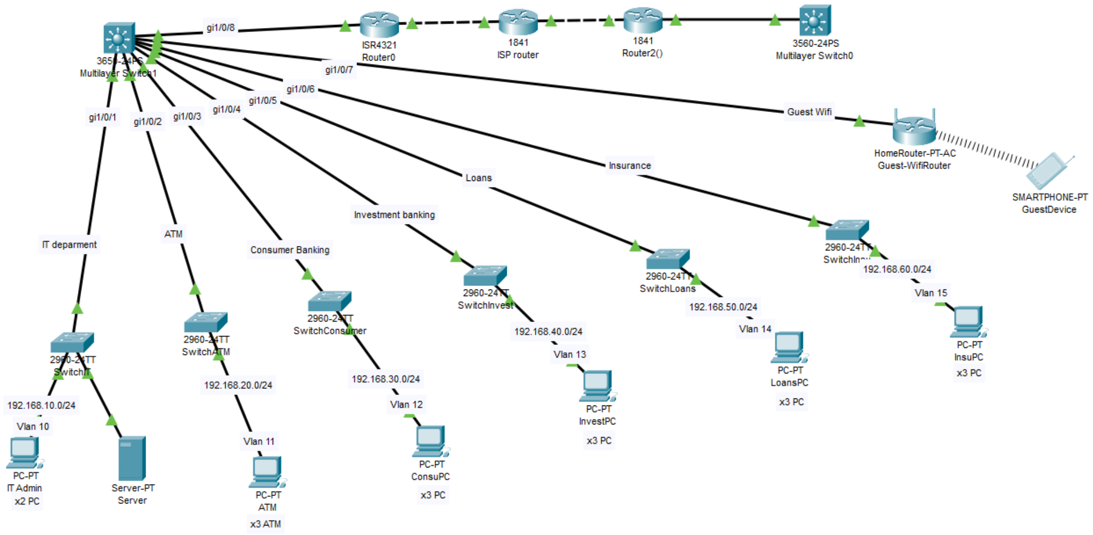

Figure 3.1: Overview of entire network

3.2 Results Analysis/Testing

3.2.1 Items and Labor cost

Model	Quantity	IP Price per unit (RM)	Total (RM)
WS-C2960-24TT-L Cisco 2960 Switch 963	6 5778	N/A	N/A
CISCO1841 Cisco 1841 Router	S2	2445	4890
WS-C3650-24PS-S Catalyst 3650 Switch	1	5121	5121
100m CAT5e Ethernet Cable	40	212	8480
TP-LINK EAP115	1	179	179
Cisco UCS C-Series Rack Servers	1	6573	6573
PC	14	5000	70000
-	-	-	Total (RM) 105999
Labor / intangible cost Unifi 100Mbps (per month		125	125
Technical support (per month)	5	4000	20000
Electrician	5	3000	15000
Network design and planning (hours)	24(hours)	20000	20000
			Total (RM) 161124

3.2.2 Network Disaster Recovery Planning

A network disaster recovery plan includes a set of procedures required to effectively respond to a disaster that affects a network and causes its disruption. The main purpose of network disaster recovery is to ensure that services can be delivered to customers despite a disruption in network connectivity.

3.2.3 Back up network configuration files

The main aim is to ensure that a network is restored to its normal state as rapidly as possible. That is why it is important to regularly back up network configuration files, including the initial parameters and settings for configuring network devices. Regarding this, you are advice to install third-party data protection software, which can be used to back up and recover critical data when your infrastructure is hit by a disaster.

3.2.4 Regularly test and update the plan

By regularly testing and updating network disaster plans, it will reduce the chances of panicking when a network disaster occurs. IT recovery team will be more ready and prepared to deal with network disasters.

3.2.5 Assess potential risks and threats

You also need to determine risks and threats which your organization is most exposed to that can disrupt your network services. After assessing potential dangers, you can come up with preventive measures to stop them from occurring to reduce the possible impact on your infrastructure.

3.2.6 Create an IT recovery team and assign responsibilities

It is not enough to create a network disaster recovery plan; you should also decide who will implement the plan when an actual disaster strikes. So, by having an IT team recovery team will have the organization prepared for disaster recovery. Each recovery team member should be assigned with a specific role and a unique set of responsibilities to avoid any confusion and panic during a disaster recovery event.

3.2.7 Document steps of the network disaster recovery process

By documenting the steps of the network disaster recovery process will avoid confusion when the actual network disaster occurs. By listing the document also helps identify the weakness of the infrastructure of the organization which indirectly reduce network disaster from occurring.

3.3 Results Overall Discussion

the chapter also discusses risk assessments, emergency response procedures, and recovery response procedures. Risk assessments involve identifying potential threats and rating their impact on the network. Emergency response procedures cover various aspects such as evaluating current plans, identifying hazards, reviewing codes and regulations, and implementing training programs and communication strategies.

Regarding the general discussion about the results, this chapter should include a comprehensive analysis of the effectiveness and efficiency of the network disaster recovery plan. The discussion should elaborate on how the objectives were achieved and the measures taken to address potential issues and problems. For example, the discussion might cover the success of the backup and recovery process, how the regular testing and updates helped in better preparedness, the effectiveness of the preventive measures in mitigating risks, and the coordination and effectiveness of the IT recovery team during a simulated disaster scenario.

Furthermore, the chapter should include an evaluation of the overall plan, considering any challenges faced during implementation and the lessons learned from the process. If there were any detected weaknesses or areas of improvement, these should be addressed, and recommendations for enhancing the disaster recovery plan should be provided.

The general discussion should serve as a reflective analysis of the entire disaster recovery planning process, highlighting its strengths and identifying areas for improvement. By incorporating a thorough discussion of the results and the plan's outcomes, this chapter adds value by providing insights and recommendations for future enhancements to ensure the network's resilience and continuity in the face of disasters.

3.3.1 Complex Engineering Problem Discussion

The network design and implementation for AHB Bank's new branch involve a combination of hardware selection, configuration, and proper planning to address the complex engineering challenges. The team must also consider the trade-offs between performance, security, and cost to create an efficient and effective network solution for the bank's operations.

Chapter 4

Conclusion

4.1 Discussion

AHB Bank is setting up a new 3-storey branch in Glenmarie Business Park, Shah Alam Malaysia. The network system is designed to have 6 departments - Internal IT Support, ATM Services, Consumer Banking, Investment Banking, Loans, and Insurance. Each department's network is separated, but they can communicate with each other using an internal chatting system via port 465. The network also includes a guest WiFi network for customers. The team responsible for implementing the network system consists of Ong Kha Hong as the Lead Network Engineer and Nicholas Lim Eng Han as the Network Administrator.The network is designed with several objectives, including separate department networks, remote access for IT support, isolated ATM network, secure access control through VLANs, and balanced performance, security, and cost-effectiveness. The network design includes multiple sites for each department, interconnected by a main Multilayer Switch acting as the Layer 3 switch. Trunk connections are used between switches to enable VLAN traffic. DHCP is implemented for automatic IP configuration. The network disaster recovery plan focuses on backup of configuration files, regular testing and updating of the plan, risk assessments, and establishment of an IT recovery team with assigned responsibilities. The network design successfully fulfills the client's requirements for separate department networks, secure access controls, and a guest WiFi network. The use of VLANs and ACLs ensures proper communication between departments while maintaining isolation where needed. The network is designed with an expected uptime of 99.99 perchant and an undiscovered error rate of 0.01 perchant, which indicates high reliability. The total cost of the hardware and labor for implementing the network is estimated to be RM 266,123. The disaster recovery plan outlines various measures to prevent, prepare for, mitigate, and respond to network disasters effectively.

Overall, the network design aligns well with the client's objectives and requirements, providing a secure, reliable, and cost-effective solution for AHB Bank's new branch.

4.2 Limitations

The proposed network design for AHB Bank has several limitations that need to be considered:

- Budget Constraints: The project has a budget of RM200,000, which may limit the scope of the network design. With a limited budget, it might be challenging to implement high-end hardware or advanced security measures, potentially impacting network performance and security.
- Scalability: The network design appears to cater to the immediate needs of AHB Bank. However, it might face challenges if the organization experiences rapid growth or expansion. The design should consider future scalability requirements to accommodate additional departments or increased user demands.
- Single Points of Failure: The network topology lacks redundancy and high availability features. If a critical device or link fails, it could disrupt communication and services across departments. Implementing redundancy measures like backup links, redundant switches, or power sources would enhance network reliability.
- Security Risks: While an Access Control List (ACL) is used to control access between VLANs, more robust security measures might be required, especially for protecting sensitive customer data. Advanced security solutions like intrusion detection systems (IDS), intrusion prevention systems (IPS), and more granular access controls might be necessary.
- Lack of Network Monitoring and Management: The proposal does not mention the implementation of network monitoring tools or a Network Operations Center (NOC) for proactive network management. These tools are crucial for real-time monitoring, issue detection, and faster problem resolution.
- Guest Wi-Fi Security: The guest Wi-Fi network may need additional security measures to protect both guest users and the bank's internal network. Implementing guest isolation and traffic filtering could reduce potential threats from unauthorized access.
- Disaster Recovery and Business Continuity: While the disaster recovery plan is outlined, it may require further development and testing to ensure smooth recovery in case of a network failure or disaster. Regular testing of the plan is essential to validate its effectiveness.
- User Training: A well-designed network also requires well-trained staff to operate and manage it efficiently. Adequate training for IT staff and end-users is crucial to ensure the network's smooth functioning and to address any issues promptly.
- Regulatory Compliance: The network design should comply with relevant industry regulations and security standards to ensure data protection and avoid potential legal issues.
- Future Technology Considerations: The proposed network design does not account for future technological advancements or changing business requirements.

A more forward-looking approach might involve considering emerging technologies and their potential impact on the network.

4.3 Scope of Future Work

- As the bank grows and the network usage increases, there will be a need to continuously optimize network performance. This may involve upgrading network devices, increasing bandwidth capacity, and implementing Quality of Service (QoS) policies to prioritize critical applications and ensure smooth communication.
- Enhanced Security Measures: To stay ahead of evolving security threats, the network should undergo regular security assessments and updates. Implementing advanced security solutions like intrusion prevention systems (IPS), data loss prevention (DLP), and threat intelligence will help bolster the network's security posture.
- Network Monitoring and Management: Setting up a Network Operations Center (NOC) or using advanced network monitoring tools will enable real-time monitoring, proactive issue detection, and faster problem resolution. This ensures that network performance and security are continuously monitored and maintained.
- Redundancy and High Availability: As the network becomes more critical to the bank's operations, introducing redundancy measures and high availability features will enhance network reliability and minimize downtime. Implementing redundant links, power sources, and switches will help avoid single points of failure.
- Network Scalability Planning: Considering the bank's potential growth and expansion, future network design should include scalability planning. This involves designing the network architecture to accommodate new departments, additional users, and emerging technologies.
- Cloud Integration: Exploring the integration of cloud services can help optimize network resources and improve cost-effectiveness. Cloud-based applications and services can offload some processing and storage demands from the local network, improving performance and reducing hardware requirements.
- Network Automation: Implementing network automation tools and technologies can streamline network management tasks and reduce human errors. Automation can be used for configuration management, provisioning, and troubleshooting, increasing operational efficiency.
- Disaster Recovery Testing: Regular testing of the disaster recovery plan is crucial to ensure its effectiveness. Conducting periodic drills and simulations will help identify any weaknesses in the plan and allow for necessary adjustments and improvements.

- Compliance and Regulatory Updates: As industry regulations and security standards evolve, the network design should be regularly reviewed to ensure compliance. Keeping up with the latest requirements will help maintain data protection and legal compliance.
- Emerging Technologies: Staying informed about emerging technologies relevant to the banking industry will allow for future-proofing the network. Exploring technologies like 5G, Internet of Things (IoT), and software-defined networking (SDN) can offer new opportunities for network enhancement.
- User Training and Awareness: Regular training sessions and awareness programs for IT staff and end-users will foster a culture of cybersecurity and network best practices. Educating employees about potential threats and safe network usage will strengthen overall network security.

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[My contributed parts are chapter 1 and chapter 2 :
Chapter 1 (Introduction) and
Chapter 2 (Design/Development/Implementation of the Project)]